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PATENT COOPERATION TREATY



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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P26174	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/DE2003/002112	International filing date (day/month/year) 25 June 2003 (25.06.2003)	Priority date (day/month/year) 25 June 2002 (25.06.2002)
International Patent Classification (IPC) or national classification and IPC G01R 31/316		
Applicant INFINEON TECHNOLOGIES AG		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of <u>6</u> sheets, including this cover sheet. <input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT). These annexes consist of a total of <u>3</u> sheets.
3. This report contains indications relating to the following items: I <input checked="" type="checkbox"/> Basis of the report II <input type="checkbox"/> Priority III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability IV <input type="checkbox"/> Lack of unity of invention V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement VI <input type="checkbox"/> Certain documents cited VII <input type="checkbox"/> Certain defects in the international application VIII <input type="checkbox"/> Certain observations on the international application

Date of submission of the demand 14 January 2004 (14.01.2004)	Date of completion of this report 01 December 2004 (01.12.2004)
Name and mailing address of the IPEA/EP	Authorized officer
Facsimile No.	Telephone No.

Form PCT/IPEA/409 (cover sheet) (July 1998)

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/DE2003/002112

I. Basis of the report

1. With regard to the elements of the international application:*

- ☐ the international application as originally filed
- ☒ the description:
pages _____ 1-15 _____, as originally filed
pages _____, filed with the demand
pages _____, filed with the letter of _____
- ☒ the claims:
pages _____, as originally filed
pages _____, as amended (together with any statement under Article 19
pages _____, filed with the demand
pages _____ 1-12 _____, filed with the letter of _____ 17 November 2004 (17.11.2004)
- ☒ the drawings:
pages _____ 1/1 _____, as originally filed
pages _____, filed with the demand
pages _____, filed with the letter of _____
- ☐ the sequence listing part of the description:
pages _____, as originally filed
pages _____, filed with the demand
pages _____, filed with the letter of _____

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language _____ which is:

- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheets/fig _____

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rule 70.16 and 70.17).

** Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**1. Statement**

Novelty (N)	Claims	1-12	YES
	Claims		NO
Inventive step (IS)	Claims		YES
	Claims	1-12	NO
Industrial applicability (IA)	Claims	1-12	YES
	Claims		NO

2. Citations and explanations**1. Reference is made to the following documents:**

D1: TAO J et al: "Electromigration under time-varying current stress", Microelectronics and Reliability, Elsevier Science Ltd., GB, Vol. 38, No. 3, 1998, XP008025212, ISSN: 0026-2714

D2: Jones, Robert E., Smith, Larry D.: "A new wafer isothermal Joule-heated electromigration test for rapid testing of integrated circuit interconnect", Journal Of Applied Physics (1 May 1987), Vol. 61, pages 4670-4678, New York, USA, XP002263291

D3: US-A-5291142 (Ohmi) 1 March 1994

2. Novelty**2.1. Claim 1**

2.1.1. Document D3 discloses an electromigration testing apparatus (cf. column 1, lines 6-10) with

- a direct current source (cf. column 3, lines 50-54: "...AC superimposed on DC current...", used as a "second current supply means");
- an alternating current voltage source (cf. column 3, lines 50-54: "...AC superimposed on DC current ... used as a "second current supply means");

- a circuit with at least one conductive structure to be tested (cf. column 2, line 15: "interconnector pattern") electrically coupled to the DC source and the AC voltage source (cf. column 2, lines 14-17: "...by applying a first electric current ... by applying a second electric current...");
- and a measuring device configured such that it measures an electric parameter that is indicative of an electromigration in the conductive structure to be tested (cf. column 3, lines 37-43: "means for measuring resistance");
- the direct current source being designed to create conditions in the conductive structure that accelerate electromigration (cf. column 4, lines 42-46: "Then, the current is gradually increased ... stress current is determined according to material and temperature" and column 1, lines 41-43 (prior art background), "...a current of about ... to accelerate electro-migration", as a result of which the "second current" also serves to accelerate electro-migration; cf. column 4, lines 64-66: "In case of AC, the electromigration effect ... is suppressed," as a result of which only the DC component contributes to the acceleration of electromigration);
- the alternating current voltage source being designed such that it applies an alternating current to the conductive structure to be tested and in this way heats the said conductive structure to a predetermined adjustable temperature (cf. column 4, lines 42-44, "...to a second current so that the temperature ... rises to a prescribed value").

- 2.1.2. The subject matter of claim 1 differs from D3 in that the alternating current regulates the temperature independently of a direct current from the direct current source.
- 2.1.3. Document D1 discloses an electromigration testing apparatus with Joule heating as well as a direct and alternating current source (cf. D1, abstract and page 305, column 2, lines 12-39).
- 2.1.4. The subject matter of claim 1 differs from D1 in that the temperature of the conductive structure to be tested is regulated by the alternating current.
- 2.1.5. Document D2 discloses an electromigration testing apparatus with Joule heating.
- 2.1.6. The subject matter of claim 1 differs from D2 in that an alternating current voltage source is used to heat the testing element to a predetermined adjustable temperature.
- 2.1.7. Therefore, the subject matter of claim 1 is novel and satisfies the requirements of PCT Article 33(2).
- 2.2. Claim 8
Claim 8 discloses a method corresponding to claim 1. For this reason, the arguments with respect to claim 1 also logically apply to claim 8.
- 2.3. Claims 2-7 and 9-12 are dependent claims and thus likewise satisfy the requirements of PCT Article 33(2).

3. Inventive Step

3.1. Claim 1

3.1.1. The effect of regulating the temperature only by means of alternating current independently of a direct current from the direct current source is that the alternating current does not influence the electromigration process and thus permits a Joule effect temperature adjustment across the entire parameter range.

3.1.2. The technical problem to be solved can thus be seen as that of permitting a Joule effect temperature adjustment across the entire parameter range.

3.1.3. In document D3, a superimposed direct and alternating current (cf. column 3, lines 50-54) is used to accelerate electromigration and to adjust temperature (cf. column 4, lines 42-46). Document D3 further indicates that an alternating current does not influence the electromigration process (cf. column 4, lines 64-66). As a result, the alternating current is used only for Joule heating. It is therefore obvious to a person skilled in the art to select a constant or a cyclically invariable direct current in order to ensure a prescribed influence on electromigration that is comparable to other test series. Conversely, it is obvious to a skilled person that temperature regulation in a system such as that described in D3 must then be carried out by the alternating current.

3.1.4. Therefore, the subject matter of claim 1 does not involve an inventive step within the meaning of PCT Article 33(3).

3.2. Claim 8

Claim 8 discloses a method corresponding to claim 1. For this reason, the arguments with respect to claim 1 also apply to claim 8.

3.3. The additional features of claims 2-7 and 9-12 are not inventive (PCT Article 33(1) and (3)) because, insofar as they do not arise from a combination of D3 with D1 or D2 (see passages cited in the search report), these claims represent conventional measures that a person skilled in the art would anticipate.

4. **Inventive Step**

Claims 1-12 satisfy the requirements of PCT Article 33(4).